UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AUTOMATIC IRRIGATION SYSTEM WITH IOT

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Electronics Engineering Technology (Industrial Electronics) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) With Honours. The member of the supervisory is as follow:

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ABSTRAK

Sektor pertanian menyumbang 4% kepada ekonomi negara dan semakin berkembang pesat selari dengan teknologi zaman kini. Sehubungan dengan itu, beberapa aspek yang telah dititik beratkan dalam usaha untuk meningkatkan mutu hasil daripada pertanian untuk diekspot ke luar negara. Kadar suhu persekitaran adalah sangat penting bagi tanaman kerana suhu persekitaran memberi impak kepada kesuburan tanama dan memberi hasil yang bermutu tinggi. Selain itu, suhu juga memainkan peranan penting dalam proses mengeluarkan hasil tanaman yang sekata dan mengikut jadual. Selain daripada suhu, kelembapan tanah juga adalah aspek penting dalam sektor pertanian. Di dalam pertanian, kadar perjalaan akar sebuah tanaman menentukan tempoh sesebuah tanaman untuk menghasilkan buah mengikut musim. Jika tanaman yang terlalu kering kelembapannya, perjalaran akar mengambil masa yang lebih lama untuk mencari sumber air dan kelembapan air bagi setiap kawasan adalah berbeza. Ini juga akan melambatkan proses penumbuhan tanaman dan merencatkan jadual penuaian tanaman tersebut.Tanaman yang sangat mementingkan kawalan suhu dan kelembapan tanah adalah tanaman sayur-sayuran. Oleh kerana hasil yang diperolehi akan dijadikan makanan kepada manusia, ia sangatlah penting untuk menjaga kualiti tersebut. Sayur-sayuran yang dieksport mestilah berkualiti tinggi dan tahan lama. Kadar suhu yang diperlukan bagi tanaman sayur- sayurana adalah sekitar 27ºC dan kelembapan tanah bawah daripada 700. Jika parameter ini dikawal dan dijaga dengan baik, tanaman tersebut akan tumbuh dengan subur dan menghasilkan hasil yang berkualiti.

ABSTRACT

The agricultural sector contributed 4% towards the national economy and is expanding rapidly in parallel to the present technological advancement. Therefore, great emphasis have been made on several aspects of the means to increase the quality of the agricultural produce for export purpose. The rate of overall temperature is very important towards the growth of the plants since it has a direct impact towards the fertility of the plants and will also result in a higher quality agricultural produce. Moreover, the overall temperature is also very important towards the production of a consistent agricultural produce and according to schedule. Apart from the overall temperature, soil humidity is also another important aspect in agriculture. In the agricultural sector, the of growth of the roots of the plants will determine the plants ready to be harvested according to its respective seasons. If the humidity is too dry for the plants, the growth and elongation of the roots in the search for the source of water, while the humidity or source of water differs from one location to another. All these will result in an overall slower growth rate of the plants, hence affecting the schedule for harvesting the agricultural produce. Vegetables are amongst that vegetation that requires temperature control as well as the right soil humidity. Since the vegetable produce is for human consumption, it is very important to ensure their quality. Vegetable produce that are especially meant for export purposes must be of highest quality and have longer shelf span. The rate of overall temperature required for vegetable to grow well is around 27°C and soil humidity at a rate of below 700.If these parameters can be taken care and well controlled, these will enable the vegetation to be fertile and grow well and will bear vegetable produce of the highest quality.

DEDICATION

This thesis is dedicated to my beloved parent, who always have my back

Bakar Redin Bin Ahmad and Nor Azilah Binti Abd Rahman Shafawi

My supervisor for their guidance and encouragement

Mr. Zulhairi Bin Othman

And all of my friends

Thank you for their encouragement and unconditionally support

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To sum up, a great thank to my friends and colleagues who there with me through out this Bachelor Degree study and helpful to support each other until this moment. Every help that they gave were very meaningful to me.

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AC	-	Alternating Current
AD	-	Anno Domini (Jesus Christ birth)
ADC	-	Analog to Digital Converter
AREF	-	Analog Reference
AVR	-	Automatic Voltage Regulator
BC	-	Before Christ
C	-	Celsius
CPU	-	Central Processing Unit
DAC	-	Digital to Analog Converter
DC	-	Direct Current
F	-	Fahrenheit
GND	-	Ground
GPIO	-	General Purpose Input Output
GPU	-	General Processing Unit
GSM	-	Global System for Mobile
GUI	-	Graphical User Interface
I/O	-	Input/Output
IC	-	Integrated Circuit
ICSP	-	In-Circuit Serial Programming
IDE	-	Integrated Development Environment
ISM	-	Industrial, Scientific and Medical Radio Bands
LCD	-	Liquid Crystal Display
LED	-	Light-Emitting Diode
MAC	-	Media Access Control
MISO	-	Master In Slave Out
MOSI	-	Master Out Slave In
PWM	-	Pulse Width Modulation
RAM	-	Random Access Memory

RF	-	Radio Frequency
ROM	-	Read-only Memory
RX	-	Receiver
SCK	-	Serial Clock
SD	-	Security Digital
SIM	-	Subscriber Identity Module
SMS	-	Short Message Service
SPI	-	Serial Peripheral Interface
TX	-	Transmitter
UART	-	Universal Asynchronous Receiver-Transmitter
USB	-	Universal Serial Bus
VCC	-	Voltage Supply
Vin	-	Voltage in
WAN	-	Wide Area Network
WISC	-	Wireless In-Field Sensing and Control
WSN	-	Wireless Sensor Network

CHAPTER 1
INTRODUCTION

1.0 Overview

This chapter will give a brief explanation about the irrigation system project as the irrigation system is important to the agriculture. The irrigation system could be applied in the Malaysia Agriculture Department.

1.1 Background

Agriculture is one of the premier sectors in Malaysian economy that involved in the international trade market because agriculture was the food resources for Malaysian citizen. The Malaysia agriculture sector growth 3.9% for every farmers in Malaysia (Sinar Harian, 2016). The evolvement of the technology gave a big advantages to the agriculture by the irrigation system water supply and monitor the growth of the crops. The quality of the production increasing and the farmers gain benefit to the arrival of the technology. The Malaysian government supports the technology to the agriculture sector and start a campaign to support Malaysian agriculture products.

The government also prepared a budget for the agriculture sector because Malaysia agriculture products have a high demand from the exporters across the world. Therefore, the quality of the agriculture products need to be maintained and an embedded technology developed to achieve the goals. Everybody knows that Malaysia location on the Earth Equator with high temperature throughout the season and rainy season for a certain period. The moisture content of the soil and temperature are the

important aspect for the growth of the crops and as a farmers they must maintain the content of the soil with the temperature. With the help of the current technology, the farmers able to monitor the content of the soil with soil moisture sensor and the temperature with the temperature sensor. Every data collected stored in a database so the farmers easily monitor the reading form the sensors anywhere far from the field and control the irrigation water supply.

1.2 Problem Statement

There are a several problems statements highlighted during the research related to this project in order to improve the quality and quantity for the production.

Firstly is the water supplied to the crops. Every plants requires different amount of water with certain time period. Starting from the seed, the farmers should know the quantity of the water need until the crops grows for a production stage. In the earlier stage, the seed only need a small amount of water with a direct sunlight which the sunlight is not a problem due to the Malaysia weather. There are two consequences for the seeds unable to grow which if the water supplied exceed the necessary amount and the water supplied below the necessary amount.

Besides that, the temperature control also need to be considered as the important aspect for the growth of the crops. A high temperature of the soil could affected the seed lifespans and this could reduce the production quantity. The seeds is just like a normal living creatures which they unable to live with a high temperature surroundings. A continuous high temperature weather could heat up the soil temperature and it could damages the soil temperature without control.

Lastly, the seeds or crops need a full attention from the farmers which means the farmers need to irrigate the field as schedulable. As a human beings, there is a possibility that the farmers forgot to follow the schedule once or twice. This means the crops received the necessary supply a bit late from the schedule. Even though the crops still receive the supply just a bit late form the schedule, this could affected their growth out of schedule. As an example, the plants requires two months to reach the production stage but with this problems, the plants takes a bit longer the reach the production stage.

1.3 Objectives

To overcome the problem stated above, a few objectives focussed to achieve the purpose of the project. The objective of this project is:

- To control the water supplied to the plants.
- To control the temperature at ± 27ºC and moisture level (<700) of the soil.
- To monitor the irrigation process remotely.

1.4 Scope of work

This project consists two parts: hardware and software. The hardware part, Arduino UNO microcontroller, soil moisture sensor, temperature sensor and DC motor pump to monitor and control the irrigation system.

The sensors send the actual reading to the Arduino UNO microcontroller and the DC water pump motor allow an amount of water to flow. The Arduino UNO acts as the brain in the irrigation system. The Arduino UNO receive the reading value and send commands to start the irrigation process. The Arduino UNO also displayed the sensors reading value to the farmers. The data received by the microcontroller stored in the cloud as it could be monitored time by time and as a comparison if there any damages in the production. The volume of water irrigate to the field is in the hand of the farmers via the mobile phone. The farmers also receive an information if the sensor value below than the threshold value.

1.5 Project Structure

The project structure divided into five categories which were introduction, literature review, methodology, and result and discussion conclusion. The implementation of Automatic Irrigation system discussed in the following chapter.

Initially Chapter 1 introduces the overview for the project. A brief explanation included in the background of the project. Problem statement, objective, work scope and project structure included in the first chapter.

Chapter 2 discussed the existing and related project by other developer. The equipment and component used in the project discussed and a comparison made to choose the best option of the component for this project.

The flowchart of the project designed in the methodology, Chapter 3, to explain how the process of the project. The flowchart algorithm of the irrigation system controlled by the microcontroller by itself with the help of the sensors.

Furthermore, the next chapter provide the result for the irrigation system project. The sensors output graph and volume of water supplied within the time displayed in Chapter 4. Analysis of the project based on the obtaining result discussed in this chapter.

Finally, the last chapter concludes the overall process of the project starting from the beginning until the completion of the project. A few recommendation in terms of future work discussed in the Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, a guide and relevant topic about the important aspect for agriculture in Malaysia. The agriculture sector growth rapidly in Malaysia and considered as one of the main sector in Malaysia. Due to the Malaysian surface and climate, the agriculture sector provide a high profit to the Malaysia economy.

The main aspect to be considered in the agriculture sector were the quantity of the water to the plants and the quality of the fertilizer. Every plants have different quantity of water needed and a specific fertilizer required to ensure the growth of the plants. Since the germination of the plants, every plants needed a quantity of water and it increased during the growth of the plants. There were several irrigation technique used by the farmers to control the amount of water in agriculture.

Ditch Irrigation

This technique is rather a traditional method in agriculture, where the seedlings were planted in rows alongside to the ditch. Mostly the water flows in the ditch naturally comes from natural creeks and nearby rivers. The water from the ditch flows through a tube and the flows out to the plants.

Drip Irrigation

A popular technique used in the agriculture sector. This technique supply the water and the fertilizer to the plants. The roots of the plants received

a continuous little by little drop of water though a water tubing. This technique were popular among the farmers because it reduced the water evaporation and high efficiency but it is limited to a small or medium areas. The drip irrigation system shown in Figure 2.1.

Figure 2.1: Drip Irrigation technique

Sprinkler Irrigation

This technique is similar to the natural irrigation that comes from the rain. This technique able to cover a wide areas up to 100 feet. The sprinkler irrigation does not concentrate on a specific seeds but its rotation covered the whole area of the farm. The sprinkler placed in the middle of the farm and the water pump able to control the volume of the water to the sprinkler. Sprinkle irrigation is shown in Figure 2.2.

Figure 2.2: Sprinkler Irrigation technique

Terraced Irrigation

It is one of the traditional technique and used in a certain areas only. It is either naturally a mountain that consists of terrace or level of steps into the slope developed by the farmers. The flat steps where the place used for planting and the water drops through each step to the bottom slope. The terrace ideology reduced the water loss and soil erosion. Terraced irrigation shown in Figure 2.3.

Figure 2.3: Terraced Irrigation technique

2.1 History of the Irrigation System

The earliest irrigation found back at least 80 centuries and the irrigation technique remains an important role to the successful agricultural worldwide. The history of the irrigation briefly explained in this chapter from the earliest days to the modern days.

Egypt and Mesopotamia

The first irrigation began in 6000 BC in Egypt and Mesopotamia. During the Egypt era, the farmers able to seed the crop form the flooded water of Nile. The flooded water were diverted to the fields and this period repeated for a few month each year otherwise they crop seeds unable to grow without the water supply. A large irrigation project, construction of dams and canal was built in 3100 BC which covered up to 20 kilometres areas.

However, the flooding level was uncertain by the villagers and a high flows caused the entire villages and the crops unable to receive enough water during the low flows.

In Mesopotamia, the Tigris and Euphrates floodwaters were used similar with the era of Egypt. The canals dug by the Sumerians was considered the first ever works of engineering and they believed that the canal can be used up to 1000 years before the arrival of the technology.

Terrace Irrigation

This technique considered as an ancient technique used all over the world but mostly used in the Americas. The Zana Valley in Peru was the great example of this ancient irrigation technique and this technique were pass by through generation since 4000 BC, which among the earliest irrigation system in Americas.